

FIRE RESEARCH

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

Institute for Applied Technology
Center for Fire Research

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The Center for Fire Research -- Working to Cut America's Fire Losses

Almost daily, newspapers and TV report fires occurring throughout the U.S., but the average American gives little thought to the fire problem unless it strikes close to home. Every 12 seconds, an unwanted fire breaks out somewhere in the U.S. Fire kills nearly 12,000 Americans annually, giving this country the highest fire death rate in the world. Fire also maims and disfigures about 300,000 people and causes economic loss of about 11 billion dollars each year.

In response to these tragic losses, Congress passed the Federal Fire Prevention and Control Act of 1974. The Act established the Center for Fire

Research (CFR) located at the National Bureau of Standards and the National Fire Prevention and Control Administration. CFR has developed a research plan to show how its work may be aimed at reducing fire losses.

Every fire is the result of a fateful chain of events. If the chain of events can be broken, the unwanted fire will not occur. CFR believes that research can develop the means to combat the most common fire situations, thereby reducing fire losses.

Six links compose the chain of events in unwanted fires:

1. Type of loss - death, injury, and/or property.
2. Type of occupancy - such

as residences or industrial buildings.

3. Time of day or night.
4. Ignition source - such as matches or electrical appliances.
5. Spreading agent - such as apparel or furnishings.
6. Direct cause of loss - smoke and gas or heat and flame.

Four strategies can be used to break the chain and reduce the fire losses:

- Prevent ignition.
- Control growth and spread.
- Detect and suppress.
- Protect people.



Prevent Ignition

The objective of this strategy is to help industry provide and the consumer to buy safer products, by encouraging the use of materials which do not ignite easily. CFR works with the Consumer Product Safety Commission (CPSC) to develop the technical basis for Federal flammability standards for consumer items.

Progress has been made in the area of flammable fabrics. However, present regulations do not yet satisfactorily cover most home furnishings or clothing, two consumer areas heavily involved in fire losses. Standards have been proposed to CPSC for the flammability of upholstered furniture and clothing based on tests developed by CFR.

To reduce ignitions it is also necessary to understand the use of flame retardants which can be added to materials. The Center conducts basic scientific research to develop this understanding and to determine the possibility of producing inherently flame retardant materials.



Control Growth and Spread

Because it is impossible to prevent all fires from igniting, fire spread must be controlled to limit damage and prevent death. Work is underway to develop mathematical models which will predict how fire will grow in a room depending on the materials, geometry of the room, furnishings, ventilation, and other factors. The mathematical model will allow researchers to make these predictions of fire behavior on paper, rather than having to rely entirely on expensive, full-scale burn experiments.

Some current standard tests do not provide adequate prediction of how materials perform in a real fire. Several tests have actually been misleading. Reli-

able and inexpensive tests are urgently needed to tell manufacturers what a new product's contribution will be to fire build-up and smoke generation. In this area, the Center is developing tests for individual pieces of furniture, mobile homes, and room-corridor combinations. Similarly, the Center is developing a small-scale test to predict the flash fire potential of materials used for aircraft cabins.

Smoke and gases produced by the fire are often more dangerous than heat and flames. It is estimated that more than 80% of fire deaths are caused by the gases produced by burning materials. Common toxic products often include carbon monoxide

and hydrogen cyanide. The Center conducts a comprehensive program to study the production and effects of smoke and gases from fire. The Center's program studies the gases produced and develops test methods to rank materials by the toxic products they release during fires.

Controlling the movement of smoke and gas is another fire problem. The Center studies smoke movement patterns using an invisible tracer gas. The end result will be a computer model to predict smoke movement in buildings. The model will form the basis for the design of smoke control systems in buildings.



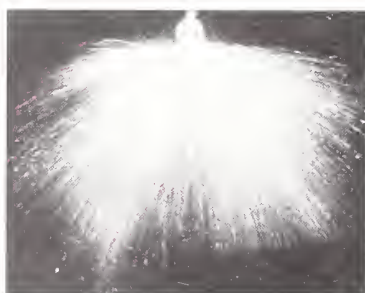
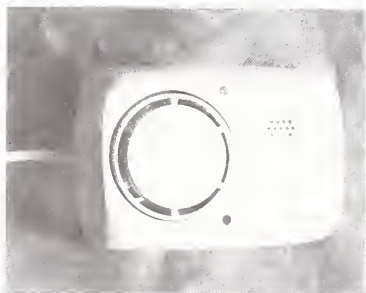
Detect and Suppress

Once fire occurs, rapid detection and suppression are critical for life safety. Smoke detectors can alert occupants who might otherwise die. Although the detector market is growing rapidly, not all smoke detectors reaching the marketplace are effective. The Center has developed tests to measure the performance of detectors and to tell where to locate detectors in the home.

CFR studies on smoke detector placement in mobile homes caused the National Fire Protection Association to rewrite this portion of its standard on mobile homes. Moreover, Under-

writers Laboratories' new standard for residential smoke detectors is based almost exclusively on performance criteria developed at the Center.

CFR is also developing design criteria for sprinkler systems appropriate for homes and apartments. Present sprinklers were originally designed to handle fire problems of 19th century textile mills and must be changed substantially to fit the needs of 20th century residences. The Center, with the National Fire Prevention and Control Administration, is analyzing data, designs, materials, and locations for home sprinkler systems.



Protect People

People protection is a matter of sounding an alert and providing escape routes or refuge areas. Building design must include emergency communication systems and refuge areas. People must also be trained to use the building's safety systems. Thus, it is a design problem plus an educational exercise.

The Center's research work is organized into fire safety guidelines for architects to use when designing buildings. As part of this effort, researchers are studying human behavior during fires. By observing how people interact

with each other and the fire, researchers are detecting patterns of behavior. These patterns of behavior are important because fire safety design cannot be effective unless it is based on how people will actually behave in a fire situation. In this way, fire safety design can be based on rationality instead of educated guessing.

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